



Pelvic Fractures in a Level I Trauma Center: A Test Case for the Efficacy of the Evolving Trauma System in Israel

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Abstract

Background: Pelvic fracture is a severe and life-threatening injury that requires treatment by a dedicated team. One of the goals of a nationwide trauma system is to provide appropriate medical care for such injuries.

Objectives: To use pelvic fractures as a test case for the efficiency of the Israeli trauma system, as reflected in the experience of our medical center.

Methods: Data were obtained from the medical charts of all cases of pelvic fractures admitted to our medical center between 1987 and 1999. We obtained demographic data, information on the cause of injury, fracture classification, co-injuries and Injury Severity Score, treatment strategies, and mortality rate.

Results: Altogether, 808 patients with pelvic injuries were treated in our medical center. The most common cause of injury was motor vehicle accidents (51%). Pelvic fractures without acetabular involvement were diagnosed in 58% of patients and isolated acetabular fractures in 32%, while 10% sustained combined injuries to the pelvic ring and the acetabulum. The overall rate of operative stabilization was 34%. The majority of patients had associated injuries, mostly additional musculoskeletal injuries. Altogether, 13% were referred from Level II/III trauma centers. We observed an increase in the total number of local admissions, in the percentage of referred patients and in the percentage of operated patients during the study period. The observed mortality rate was 5%.

Conclusions: Our results show a more than twofold increase in the percentage of referred patients following the designation of a Level I trauma center. These referrals are due not only to the designation as a Level I trauma center, but also to the presence of a dedicated team of pelvic fracture specialists, available 24 hours a day. In addition, a larger percentage of patients undergo surgery for internal fixation of pelvic fractures, in accordance with current worldwide trends.

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ters are geographically distributed and are located in large urban areas. According to the guidelines, multiple-injured people who need special intervention are referred to one of the Level I trauma centers. A large volume of the trauma work is performed by the orthopedic trauma services in these centers [2].

Injuries to the pelvic ring and to the acetabulum represent one of the most severe forms of trauma. These injuries are predominantly due to a violent impact on the pelvis [3] and are often accompanied by concomitant extra- and intra-pelvic injuries [4–6]. Pelvic fractures comprise 7.6% of injuries caused by motor vehicle accidents [3]. In poly-trauma patients the frequency of pelvic fractures increases to 18.3% [7] and in fatal motor vehicle accidents to 25% [8,9]. The severity of pelvic fractures was found to correlate with the velocity of the vehicle [9]. In order to optimize outcome, patients with complex pelvic fractures should be treated at a referral center by a dedicated team. The skills imperative for successful management of these patients include: a thorough knowledge of pelvis anatomy, interpretation of imaging data, analysis of demographic facts, consideration of associated injuries, and understanding of therapeutic pitfalls.

The epidemiology of pelvic fractures was investigated in several medical centers during the past two decades [4–11]. These studies varied in inclusion criteria, type of data collected, fracture classification system used, report of associated injuries, and outcome measures. These studies assisted in the planning of trauma systems around the world.

Parallel to the establishment of the Israeli trauma system, and the associated orthopedic trauma services, epidemiologic studies focusing on different trauma injuries are essential to provide information regarding the function and efficiency of the new system. The goal of this study was to examine the epidemiology of fractures of the pelvic ring and acetabulum in one large medical center, before and after its designation as a Level I trauma center.

Patients and Methods

The Hadassah-Hebrew University Medical Center was designated as a Level I trauma center in February 1991 and the trauma registry was initiated in 1992. Retrospective data from 1988 to 1996 were collected from patients' files, and prospective data from

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A nationwide trauma system was established in Israel more than a decade ago, with the designation of 24 hospitals as trauma centers capable of receiving trauma victims [1]. Six medical centers were defined as tertiary referral hospitals (parallel to Level I trauma centers) and 18 others as community hospitals (parallel to Level II/III trauma centers). The Level I trauma cen-

1997 to 1999 were recorded on a computerized spreadsheet.

The data included patients' demographics (age and gender), mechanism of injury, fracture classification, associated injuries and treatment modalities. The leading cause of injury was motor vehicle accident (driver, front- or rear-seated passenger, unknown), including also accident involving motorcyclists and pedestrians, followed by fall from a height, and other trauma mechanisms. Fractures of the pelvic ring were classified using the revised Tile classification [12,13] while acetabular fractures were classified using the AO comprehensive system [14]. Associated injuries were classified into head trauma and/or loss of consciousness, chest injuries and/or pneumothorax, vertebral trauma with or without neurologic involvement, visceral injuries, injuries to the urinary system, facial and extremity fractures, and severe lacerations of the skin. Fractures of the ipsilateral femur and concomitant ipsilateral dislocations of the hip were recorded. Injury Severity Score was obtained from the trauma registry. Treatment modalities included pelvic and acetabular surgery, other orthopedic surgical interventions, surgery performed by other departments, and evaluation of patients who did not require operative treatment. Also recorded were admissions to the intensive care unit, length of hospitalization, and death.

Results

Altogether, 808 patients with pelvic and acetabular fractures were treated between 1987 and 1999 in our medical center. Local admission through the emergency department was documented for 688 patients (85%), while 104 patients (13%) were referred from other medical centers in Israel [Table 1]. Mean patient age was 40 ± 23.5 years (range 2–101 years), with 59% males and 41% females. The leading mechanism of injury was motor vehicle accident, followed by falls from a height [Table 1].

Analysis of the injuries shows that 58% of the patients sustained pelvic fractures, 32% sustained fractures of the acetabulum and 10% sustained combined injuries to the pelvic ring and the acetabulum [Table 2]. According to the Tile classification, 60% of the pelvic fractures were type A, 20% were type B and 20% were type C [Table 2]. Among the referred patients, 51% sustained acetabular fractures, 35% pelvic and 14% combined injuries. Acute dislocations of the hip joint were diagnosed in 33 cases, comprising 10% of patients with fractures involving the acetabulum, while 20 patients had a floating hip [Table 2].

Associated injuries occurred in most of our patients. Facial and limb fractures (59%), followed by damage to internal organs, concussion and head trauma, and chest and lung injuries (50%, 46% and 40% respectively) were most frequently reported [Table 2]. Data regarding ISS were available for 47% of patients. Of these, 25% had a score of 4–9, 36.3% scored 10–16, and 38% scored 17–66 [Table 2].

About one-third (34%) of all patients underwent surgical treatment of their pelvic injury [Table 3]. In addition, 28% were operated for other orthopedic injuries and 15% underwent

ISS = Injury Severity Score

Table 1. Characteristics of 808 patients hospitalized with a pelvic fracture, 1987-1999

Age (yrs)	40 ± 23.5
Gender	
Male	59%
Female	41%
Hospitalization	
Local	87%
Referral	13%
Mechanism of injury	
MVA, passenger	51%
MVA, motorcycle	2%
MVA, pedestrian	20%
Fall from height	16%
Other	15%

MVA = motor vehicle accident

Table 3. Summary of treatment modalities, hospitalization, and death rate

Operation of pelvis	34%
Non-operative treatment	63%
Other general surgeries	15%
Other orthopedic surgeries	28%
ICU stay	32%
Length of hospitalization (days)	17.3 ± 17
Death rate	5%

Table 2. Type of pelvic fractures sustained by the patients and associated injuries

Fracture locations	% of total
Pelvis	58%
Type A	60%
Type B	20%
Type C	20%
Acetabulum	32%
Isolated fracture	82%
Hip dislocation	10%
Floating hip	8%
Pelvis & acetabulum	10%
Associated injuries	
Fractures	
Limbs and face	59%
Ipsilateral femur	11%
Spine	11%
Internal organs	50%
Head and consciousness	46%
Chest and lungs	40%
Urinary system	9%
Severe skin lacerations	21%
Injury Severity Score	
0–8	25.6%
9–16	36.3%
17–66	38.1%

general surgical procedures. The average hospitalization period was 17 ± 17 days [Table 3]. Thirty-four percent of the patients were discharged after 1 week, 59% after 2 weeks and 84% after 1 month, with only 4% requiring prolonged hospitalizations (over 8 weeks). Many of the high-energy trauma victims were transferred to our rehabilitation department shortly after receiving definitive treatment, making their stay in our department shorter [Table 4]. Thirty-two percent of our patients were admitted to the Intensive Care Unit. The death rate in our series was 5% (40 patients).

In order to assess changes in the number of referrals, we looked at three different periods – before the designation of Level I trauma center (1987-1991), shortly afterwards (1992-1995), and after a longer period (1996-1999). The data show a substantial increase in the number of cases referred to our medical center during these periods, from 13 cases (7.5% of patients) in the pre-designation period to 58 (16.8%) in the long-term period [Table 4]. Throughout these phases, the percentage

Table 4. Referred patients and surgical intervention, 1987-1999

Period	No. of locals	No. of referrals	% of referrals	% surgery in referred group	% surgery in local group
1987-91	160	13	7.5%	54%	22.4%
1992-95	247	32	11.5%	44%	26.3%
1996-99	286	58	16.8%	55%	35.4%

of surgeries in the referred patients group remained higher than among locally admitted patients.

Discussion

Pelvic fracture is considered one of the most severe orthopedic trauma injuries. It can serve as an example of a life-threatening condition with a high frequency of associated injuries that require a multidisciplinary team approach. Furthermore, according to data published by the Israel Ministry of Health, most injuries to the pelvis are caused by motor vehicle accidents and involve young patients [3]. These characteristics of pelvic injuries make it a proper test case for the efficiency of the evolving Israeli trauma system in general and the orthopedic trauma system in particular.

One of the goals of a trauma system is to provide specialized treatment to complex injuries [15]. The complexity of pelvic injuries is reflected in the ISS and co-injuries data [Table 2]. Accordingly, Level II/III trauma centers are instructed to use the services of the referral center (Level I) in order to provide definitive treatment by specialized orthopedic trauma surgeons. The percentage of referral patients increased by more than twofold after the establishment of the Israeli trauma system in 1992, when our medical center became a Level I trauma center [Table 4]. During that period, young senior orthopedic surgeons completed fellowship programs in orthopedic trauma, creating a dedicated team for the treatment of pelvic fractures available 24 hours a day. Moreover, local protocols for acute as well as delayed treatment were established and presented to the Israeli orthopedic community on several occasions. Similar processes occurred in other centers in Israel. The gradual increase of referrals reflects this slow process as well as assimilation of the new guidelines and regulations. The increase in the number of local admissions shown in Table 4 may be due to the growing inclination of on-site emergency medical teams to direct severely injured patients to a Level I trauma center, as required. However, since data regarding the changes in the nationwide number of pelvic fractures in parallel years are unavailable, conclusive analysis is impossible.

During the past decades, treatment strategies for pelvic fractures evolved from non-operative to operative and from external to internal fixation [12]. These changes followed better understanding of mechanism of injury as reflected in fracture classification systems [13,14,16]. In the 1980s, 2.6% of the patients underwent pelvic operation, whereas in the 1990s, 3.9% with type A pelvic fractures, 37.3% with type B, 54.3% with type C and 38.6% with acetabular fractures were treated surgically [12]. These data reflect different approaches to similar injuries in different societies as well as the evolution in management of complex pelvic injuries.

According to our data, 33% of the patients underwent surgery for their pelvic or acetabular fracture. In the referred patient group, 39% were operated and 61% were treated non-operatively. The percentage of operated patients increased [Table 4]. This is probably due to better screening methods and to the increased tendency to treat these injuries operatively. In the

group of nationwide referrals a higher percentage of patients underwent surgical treatment. Most likely, early communication between Level II/III trauma centers and the referral center, using a unified classification system and electronic imaging transfer, enabled the pre-selection of those patients requiring surgical interventions in the vast majority of cases.

The percent of patients undergoing other orthopedic surgery and general surgery was similar to other series [7]. The length of hospitalization was similar in Scandinavia and Israel, although there were considerable differences in the study groups. Many of our patients sustained high-energy trauma, compared to stable pelvic fractures in most patients in Scandinavia. The similar hospitalization periods could be explained by the tendency to transfer patients to our rehabilitation department as soon as possible. In the Scandinavian series, the patients were hospitalized until ambulation and pain control were achieved.

Mortality among pelvic fracture patients ranges from 7.2 to 64% [7–12], depending on age [10], associated injuries [10–12], and the complexity of the pelvic fracture [11,12] as well as the ISS score [7]. Pelvic injury was the main cause of death in 0.9% of 1,922 patients with pelvic fractures [12]. The general death rate from blunt trauma, or ISS score higher than 15, was similar to the death rate in patients with pelvic fractures [7]. We report a mortality rate of 5%, reflecting the importance of a referral center for fractures of the pelvis and acetabulum. The relatively low death rate in our series could be attributed to several possible causes, including an aggressive team approach according to the Advanced Trauma Life Support principles, admission to the intensive care unit on arrival as a routine, and timed operative interventions by experienced and dedicated surgeons. Furthermore, referred patients are usually those who survived the initial trauma and were stabilized elsewhere.

Summary

We present our experience with 808 pelvic fractures in a Level I trauma center, serving as a referral center for pelvic fractures. This designation leads to exposure to the entire spectrum of pelvic fractures, with complex fractures referred for definitive treatment after primary stabilization elsewhere.

A substantial increase in the percentage of referred patients was detected following the establishment of the trauma system in 1992. More than half of the referred patients underwent surgical treatment of their pelvic fracture. These data illustrate successful implementation of trauma care principles.

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